Murray's law at nanoscale

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Murray's law has provided a fundamentally physical principle to describe the phenomenon that hierarchically porous networks are naturally formed for organisms to achieve optimal mass transport performance. Extending to bio-inspired hierarchically porous nanomaterials, two assumptions (i.e., the no-slip boundary condition, and the homogeneous fluids) in the derivation of original Murray's law seem to be questionable. In this work, the interfacial effects on the confined mass transport of fluids in hierarchically porous nanomaterials are quantitatively accessed to study the Murray's law at the nanoscale. A seemingly generalized Murray's law based on the resistance matching principle has been theoretically derived and successfully used to predict the experimental phenomena. It can be foreseen that this work may provide fundamentally theoretical guidance for the rational designing of hierarchically porous nanomaterials in the fields of heterogeneous reaction, membrane separation, electrochemistry, and so on.

REFERENCES

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